



OSPREYS IN INDIANA

ACTIVITY BOOK

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A NOTE TO EDUCATORS AND PARENTS

Please take the time to share the information and utilize the activities within this booklet with your students and children. This booklet focuses on the state-endangered osprey, the 2003 Indiana osprey reintroduction project and the Indiana Nongame and Endangered Wildlife Program.

The Indiana Nongame and Endangered Wildlife Program and the Indiana Division of Fish and Wildlife strive to provide accurate information about our state's natural resources. This booklet was designed to teach others about the return of the osprey to Indiana's skies.

Funding for the reintroduction project and the development of this booklet are provided through the Indiana Endangered Wildlife Fund. The Nongame and Endangered Wildlife Program utilizes Wildlife Fund monies to protect and manage over 550 nongame and endangered animal species in the state of Indiana. Income is generated almost entirely through donations to the Wildlife Fund via the Indiana Income Tax Checkoff and direct donations to the Fund. The Nongame Program is also currently receiving a 75 percent match on every dollar spent from the Federal Wildlife Conservation and Restoration Program.

Donations to the Fund can be made at any time by businesses, schools, families or individuals to help us to continue to make projects such as this possible. More information on the Nongame Program and how to donate are available on the Division of Fish and Wildlife's website.

Thank you for your support,

Alisha Schiffli
Nongame Education Specialist





HELLO! MY NAME IS JOHN CASTRALE AND I AM GOING TO BE YOUR GUIDE TO HELP YOU LEARN MORE ABOUT OSPREYS.

I AM AN **ORNITHOLOGIST** FOR THE INDIANA DIVISION OF FISH AND WILDLIFE. WE WORK HARD TO PROTECT AND MANAGE MORE THAN 550 SPECIES OF NONGAME AND ENDANGERED ANIMALS IN THE STATE OF INDIANA. WE HOPE THAT YOU'LL JOIN US TO PROTECT INDIANA'S NATURAL RESOURCES.

AS YOU LEARN ABOUT OSPREYS, BE ON THE LOOKOUT FOR IMPORTANT KEY WORDS! FIND THE KEY WORDS BOX TO LEARN WHAT THEY MEAN.

GRAB YOUR BINOCULARS, PUT ON YOUR THINKING CAPS AND LET'S GO!

-KEY WORDS-

ornithologist - someone who studies birds, a bird biologist

OSPREY FACTSHEET

The osprey is one of the most widely distributed birds in the world, found on every continent except Antarctica. The population declined rapidly between 1950 and 1980 due to DDT, loss of breeding grounds and poaching. The banning of DDT in combination with state conservation programs has allowed the osprey to make a comeback throughout the United States. The osprey is considered endangered in Indiana.

An osprey is a **raptor or bird of prey**. Raptors are at the top of their food chain and prey on smaller animals. The osprey has special adaptations to hunt fish but will occasionally eat rodents, birds, small vertebrates and crustaceans. Although they can be very protective of their nests, they will not harm people.

Scientific name:	<i>Pandion haliaetus</i>
Nickname:	“fish hawk”
Length:	21 - 25 inches
Wingspan:	59 - 67 inches
Weight:	2.5 - 4 pounds Females are slightly larger than males.
Similar species:	Bald eagles; Eagles have larger dark bodies and fly with their wings level.
Habitat:	Because of diet, ospreys live near bodies of water.
Diet:	Feeds almost exclusively on fish
Lifespan:	Average of 18 years old in the wild
Nests:	Stick nests are usually built in dead trees and a variety of manmade structures (telephone poles or artificial platforms). Ospreys are colonial or solitary nesters and both male and female ospreys contribute to nest building.
Breeding:	Monogamous breeders; Ospreys lay three to four eggs per year.
Incubation:	32 - 43 days by both sexes, however the female does more while the male brings food. Young stay in nest 48 - 59 days.

Call: Ospreys are quite vocal birds. They sound a *kip kip kip kiweek kiweek* when alarmed. During courtship and around the nest they use a variety of soft whistling and chirping calls.

The name *Pandion haliaetus* has Greek origins. *Pandion* was the name of two mythical kings of Athens; *haliaetus* is from the Greek *hals* and *aetos* meaning “sea” and “eagle.”

-KEY WORDS-

colonial - animals of the same species that live in groups and are dependent upon one another

monogamous - mating of a male with a female involving no extra individuals of either gender. Usually birds will bond through the breeding season only and in some cases it may extend through the adult life of the two individuals

solitary - animals that live on their own without a partner or others

Osprey abundant and no protection existed for the species.

Early 1800s

Osprey considered a regular migrant and local summer resident statewide; common along the Lake Michigan shoreline.

1898

Migratory Bird Treaty Act passed

1918

Nest reported in Parke County

1931

Nesting reports in Posey County

1932 - 1969

1934

Nest reported in Porter County

1939

Paul Muller of Geigy Pharmaceutical in Switzerland discovered the effectiveness of DDT as an insecticide.

1950 - 1970

Populations decline drastically nationwide due to DDT, loss of breeding grounds and poaching.

Public awareness of damage to environment raised with the publishing of Rachel Carson's book, *Silent Spring*

1962

1971

Nest reported in Parke County

DDT banned in United States

1973

1980

Breeding ospreys not known to be in Indiana.

Osprey listed as *endangered* in Indiana.

1984

Confirmed report of breeding pair near the Ohio River

1989

One nest reported at Brookville Reservoir in Union County.

1990

Nest built and later abandoned on erected platform at Patoka Lake (Crawford County)

1995

2001

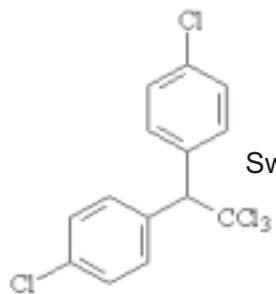
Two known nesting pairs of osprey reside in Indiana.

Indiana Nongame and Endangered Wildlife Program begins a plan for osprey restoration and management for the state.

2002

2003 - 2005

DNR biologists implement plan by reintroducing approximately 75 osprey chicks throughout the state.



OSPREYS IN INDIANA

MIGRATORY BIRD TREATY ACT

The **Migratory Bird** Treaty Act was passed by the U.S. Congress in 1918 to help protect unnecessary harm to migratory bird species.

This prohibition applies to birds included in the respective international conventions between the U.S. and Great Britain, the U.S. and Mexico, the U.S. and Japan, and the U.S. and Russia. This was the establishment of a Federal prohibition, unless permitted by regulations, to

"...pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for

shipment, ship . . . transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird." (16 U.S.C. 703)

Ospreys and other birds of prey are protected under this act. Ospreys are also protected under Indiana Administrative Rules because they are considered endangered in the state.



BIOLOGIST BIOGRAPHY:

RACHEL CARSON AND THE BIRTH OF ENVIRONMENTAL AWARENESS

Born May 27, 1907, in Springdale, Pa, Rachel Louise Carson got an early start on becoming the woman who is credited with sparking the environmental movement in the United States.

Carson received a master's degree in zoology from Johns Hopkins University in 1932 and pursued a teaching career. Carson later took a job writing radio scripts for the U.S. Bureau of Fisheries. This job turned into a 15-year career as scientist and writer at the U.S. Fish and Wildlife Service, where she ultimately rose to the position of editor-in-chief for all its publications. Carson dedicated her free time to her love of nature and writing.

She was not by nature a crusader, but when aerial spraying of DDT killed the birds in a friend's bird sanctuary, she began to



Copyright: Erich Hartmann

-KEY WORDS-

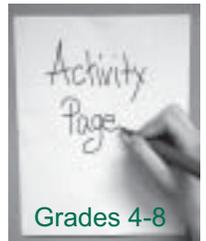
migratory bird - bird that seasonally relocates from one habitat or climate to another for feeding or breeding purposes

investigate the effects of pesticides on the chain of life. "The environment" and "ecology" have since become household words for Americans, but it all began with her *Silent Spring* in 1962.

Driven by the knowledge that the book was desperately needed, she pored over and combined the work of many individual researchers. She wrote of the heedless pesticide poisoning of our rivers and soils, warning that we might soon face a spring when no bird songs could be heard.

Rachel Carson had to weather a storm of controversy and abuse, and she did not live to see the eventual banning of DDT. But the environmentalist movement carries on the work she began, preserving our natural heritage for the future. Carson died in 1964.

BIRD IS THE WORD



See how many words you can make out of the letters of the scientific name for osprey. I've given you a few to get you started. Good luck!

Pandion haliaetus

ant
stale
panda

RAPTOR READING

Find information about ospreys and another raptor in an encyclopedia. Using complete sentences and on one page, tell me how they are alike and how they are different.

FILL IN THE BLANKS

Finish these sentences with words or phrases that you have already learned about ospreys.

1 Ospreys have special _____ to help them hunt for fish.

2 _____ animals live in groups and depend on one another.

3 A/an _____ is a biologist who studies birds.

4 The scientific name for "osprey" has _____ origins.

5 The osprey is considered _____ in Indiana.





OSPREYS ON THE INTERNET

The World Wide Web can be an excellent reference tool if used correctly. Go to each website below to find the answers to the questions on ospreys. Write your answers on a separate sheet of paper.

WEBSITE 1: INTERNATIONAL BIRDING INFORMATION RESOURCE DATA

<http://i-bird.com/species/osprey.htm>

1. According to i-bird.com, how many states and which ones have records of ospreys as “erratic, transient, casual, vagrant or rare”?
2. Using the map of the United States provided on page 21 , make your own abundance map similar to the one found on i-bird.com

WEBSITE 2: USGS PATUXENT WILDLIFE RESEARCH CENTER

Using a search engine, find the Patuxent Bird Identification Info Center.

1. What does USGS stand for?
2. According to the Info Center, how big is an osprey? Length = _____ Wingspan= _____

WEBSITE 3: NATURESERVE

<http://www.natureserve.org/explorer>

Searching by “Plants and Animals,” search for osprey by common name.

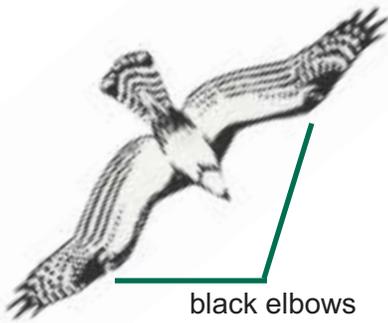
Look at the “Comprehensive Report” for the osprey.

1. What is the heritage identifier for the osprey?
2. Starting in order from Kingdom and ending with species, list the scientific classification of the osprey based on this website.
3. List the states in which ospreys are “critically imperiled.”
4. How many states are ospreys possibly extirpated from? List them.

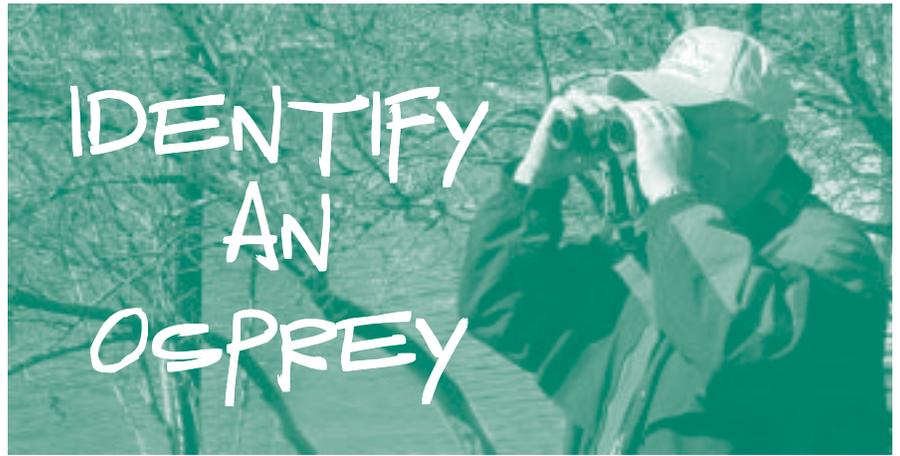
WEBSITE 4: INDIANA NONGAME AND ENDANGERED WILDLIFE PROGRAM

<http://www.wildlife.IN.gov>

1. List the four species of raptors that are endangered in Indiana. Which one is federally threatened?
2. Define the following Indiana classifications: endangered, special concern, extirpated
3. How many bird species are considered extirpated in Indiana?

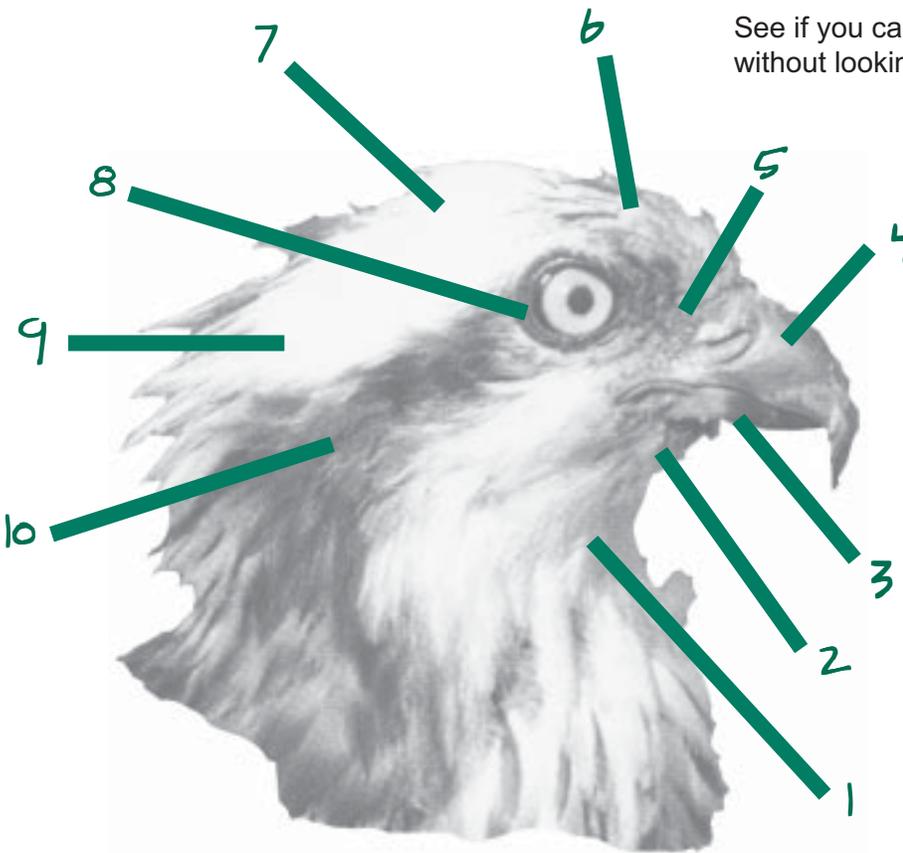


The osprey can be identified in flight by its white underparts and the distinctive crook formed by its long, narrow wings. A very unique feature is the osprey's black elbows.



An osprey can be distinguished very clearly from other birds of prey. Adults are brown to brownish-black on their backs with brownish-black marks on the wings and buff to brown speckling on the breast.

See if you can identify the parts of an osprey's head without looking at the key.



1. throat
2. chin
3. lower **mandible**
4. upper mandible
5. **lores**
6. forehead
7. **crown**
8. **eye ring**
9. **nape**
10. **eye stripe**

-KEY WORDS-

crown - top of head

eye ring - the bare skin around the eye, somewhat wider in front of the eye in falcons

eye stripe - noticeable line that extends behind the eye, sometimes also in front of the eye, usually dark

lores - the area of the face between the eye and the beak

mandible - in birds, specifically the lower jaw and beak but the term is also used to denote the two parts of the beak of a bird, as upper and lower mandibles

nape - the back of the head

RAPTORS TAKE THE SKY

Have you ever seen a raptor in the sky? It's never an easy task to properly identify which is which. Below are some images of what you might see!



bald eagle
wingspan: 6 - 8 feet



turkey vulture
wingspan: 5.25 - 6 feet



osprey
wingspan: 5 - 6 feet



peregrine falcon
wingspan: 3 - 4 feet



red-tailed hawk
wingspan: 3.5 - 4.5 feet



Cooper's hawk
wingspan: 2 - 3 feet

Images adapted from *The Missouri Conservationist*

AS LIGHT AS A FEATHER:

Ospreys have over 3,000 feathers! Feathers are different sizes and lengths and have different purposes. Birds have three different kinds of feathers on their wings called **flight feathers**. They are primary, secondary and tertiary. Tail feathers, or rectrices, also aid in flight.

Ospreys have thick, dense, oily feathers. The feathers on an osprey are oily so that the water does not harm it when it catches fish.

-KEY WORDS-

barb - like branches of a tree growing off the shaft; The barbs run parallel to each other and hook together to form the vane.

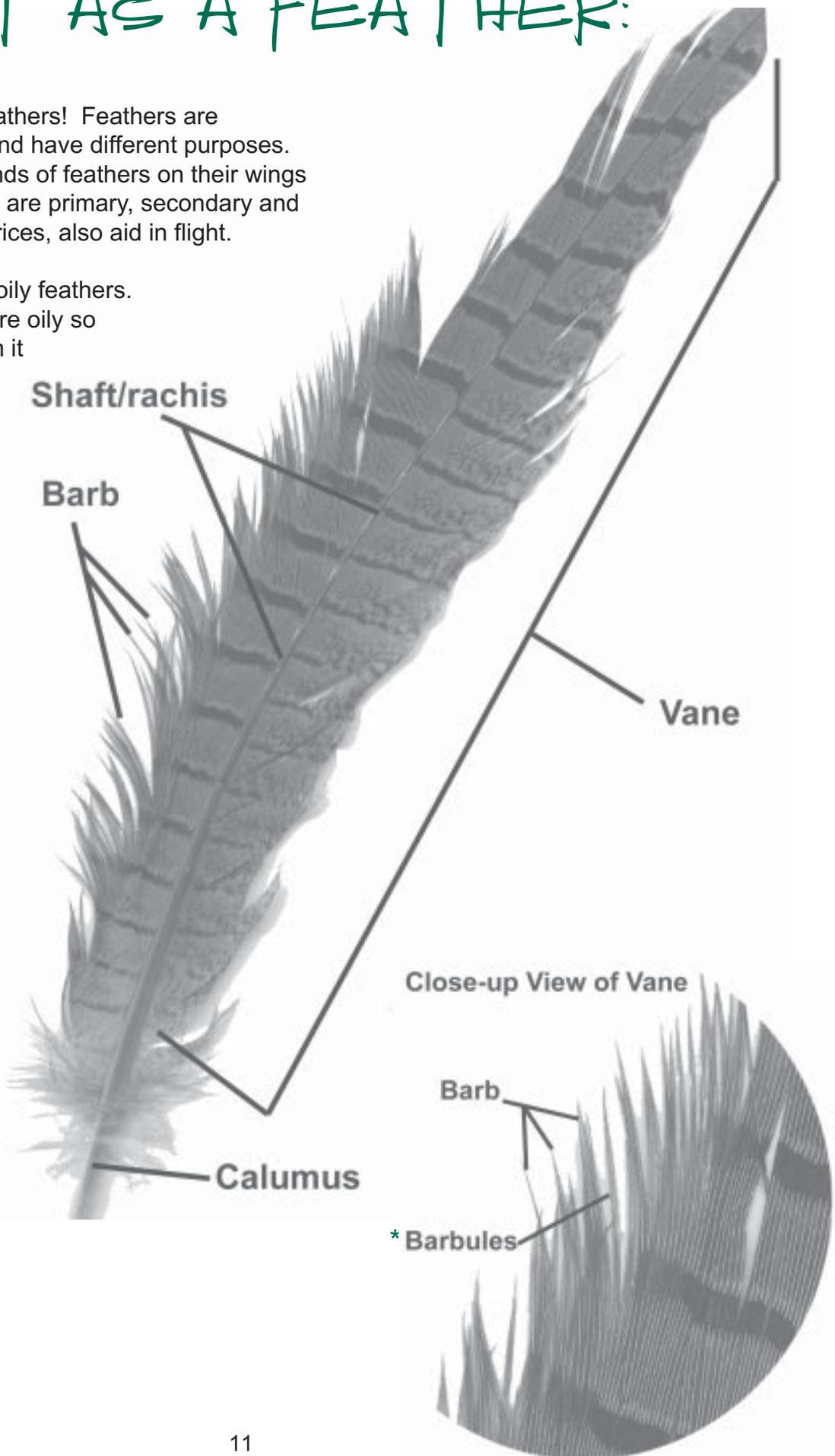
barbules* - tiny hair-like branches on the barb. They are very hard to see with the human eye. They are even too small to see here!

calumus - the end of the feather. Sometimes called a quill, the calumus is connected to the bird with skin.

flight feathers - feathers used in flight

shaft/rachis - central part of the feather, like the trunk of a tree

vane - flat parts of the feather found on both sides of the shaft; The vane is made up of barbs that hook together.



NAVIGATION



THE GREAT MIGRATION

Ospreys, like many birds, make the great winter migration south. One by one, young leave the nest to hunt on their own and gradually disperse to traditional wintering grounds. All ospreys of a region follow the same flight paths to their wintering grounds. Ospreys fly strong and hard while migrating. One osprey was clocked soaring at 80 mph in Pennsylvania!

Great Lakes populations, including Indiana, winter in the western Gulf region of Florida, generally keeping between the Mississippi River and the eastern inland mountains. The osprey migration may begin as early as late August, continuing through late November and early December.

LOCATION, LOCATION, LOCATION

There are numerous ways that birds can tell when they should migrate, where they are or in what direction they are travelling.

CELESTIAL NAVIGATION

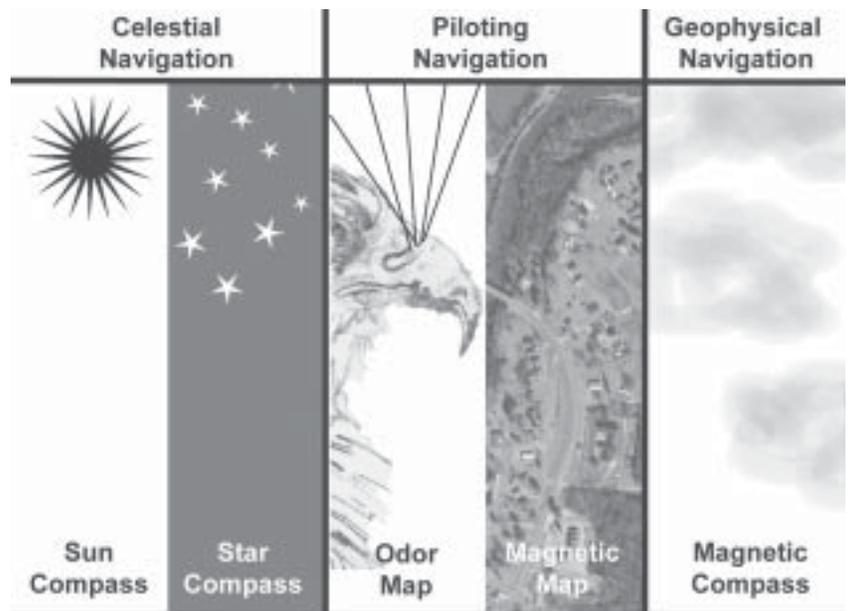
Birds use **celestial navigation** based on the positions of the sun, moon and stars. They can determine what time of day it is and what season it is. The number of hours of daylight in a day, a photoperiod, indicates to the bird what season it is.

PILOTING NAVIGATION

Piloting navigation is used to help birds find their way back home. They rely on smell and physical location of landmarks. Ospreys do not tend to utilize the odor map for navigation.

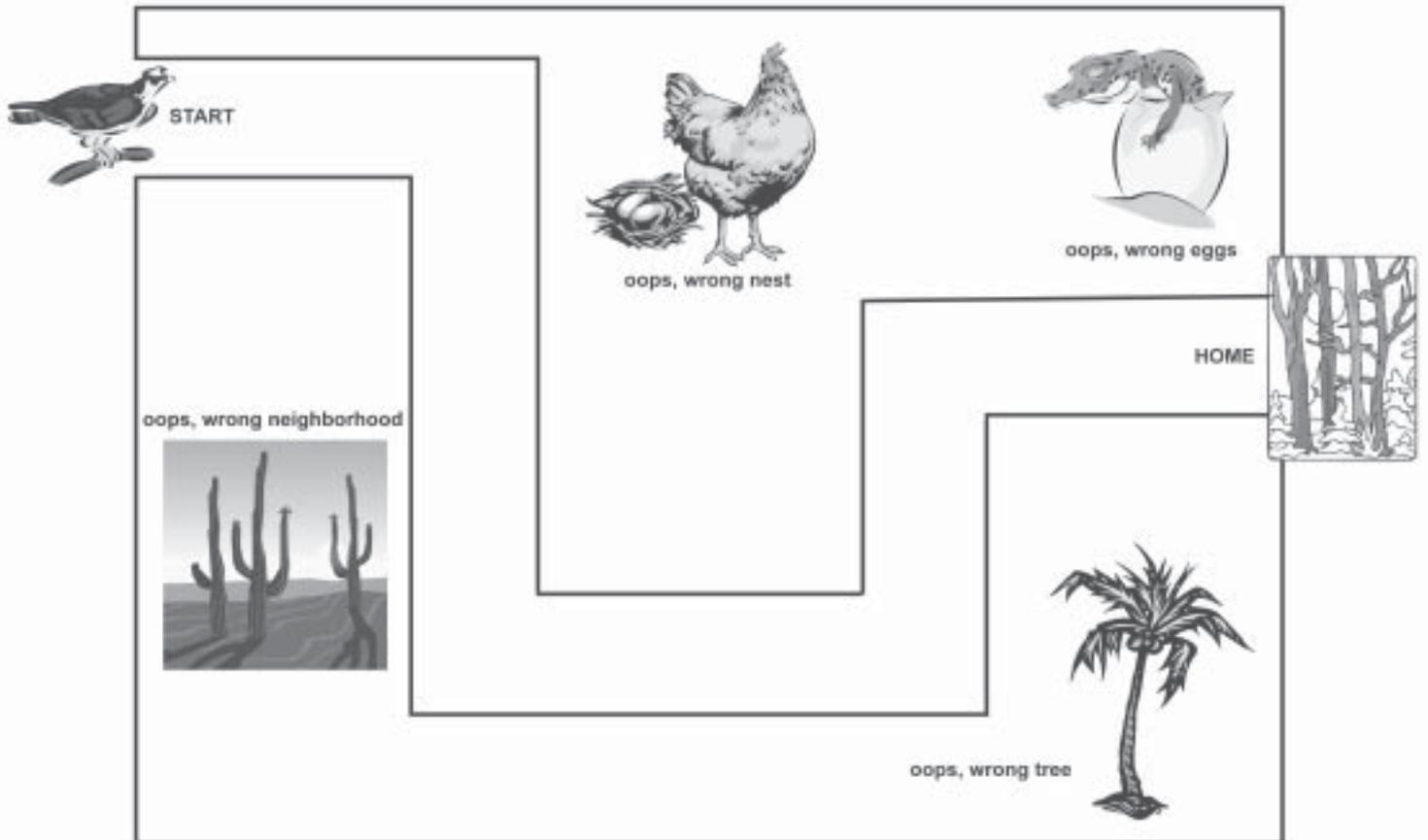
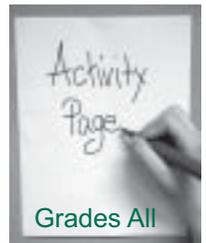
GEOPHYSICAL NAVIGATION

Birds also have a special sense of **geophysical navigation**. This allows birds to determine their location based on latitude and longitude as well as their direction. This is especially useful on cloudy, rainy or overcast days when they cannot rely on the sun. Their internal magnetic compass can sense the magnetic fields and pull of the earth, sun and moon.



MEMORY MAP

Using your own "magnetic map," see if you can help navigate the osprey to its home. Look at the maze for 10 seconds. Place your pencil on the osprey. Close your eyes and see if you can navigate to the osprey's home. No peeking!



RAPTOR RECALL

Identify each bird of prey by writing the correct letter in the blank under the picture.

- A. Turkey vulture
- B. Osprey
- C. Cooper's hawk
- D. Peregrine falcon
- E. Red-tailed hawk
- F. Bald eagle



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



PLOTTING PHOTOPERIODS

Grades 8-12

Photoperiods are not only important in navigation, but also in initiating breeding seasons. It has been discovered in the lab that by manipulating photoperiods, birds can actually be induced to lay eggs!

A photoperiod can be determined by keeping track of the total number of hours of daylight. The number of hours per day can be determined by knowing sunrise and sunset times. By plotting the number of hours of daylight on a table, you can

create your own photoperiod table.

You can create a table for a specific week, month or even year. Yearly charts are developed based on finding the average daylight hours for each month. Sunrise and sunset times can be obtained from an almanac or weather center.

Collect data for your town, find the average amount of daylight for each month for last year and plot it on a graph similar to the one below.

Math Formulas*

$\text{sunset} = u$ $\text{amt. of sunlight per day} = d$
 $\text{sunrise} = r$ $\text{average amt. of sunlight per month} = m$
 $n = \text{total number of days in month}$

$$u - r = d$$

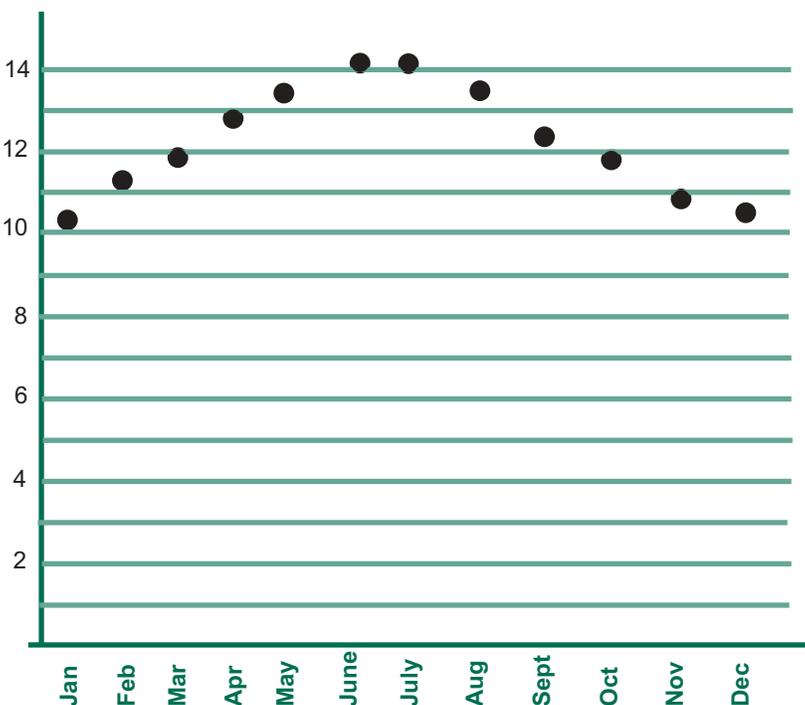
$$d1 + d2 + d3 + d4 \dots /n = m$$

$$m1 + m2 + m3 + m4 \dots /12 = \text{average amount of sunlight for 1 year}$$

(*using military time where 12:00 AM = 24:00 and 12:00 PM = 12:00)

Directions: Create your table using 24 hours of daylight.

1. Label the X-axis with an appropriate label.
2. Label the Y-axis with an appropriate label.
3. Using a calendar for the same year, determine the following dates:
 - a. First day of spring
 - b. First day of summer
 - c. First day of fall
 - d. First day of winter
4. What is the photoperiod average during the month that the following begin:
 - a. Spring
 - b. Summer
 - c. Fall
 - d. Winter
5. a. Define 'equinox' as it relates to photoperiod.
 b. Looking at your table, during which two months does it occur in your area?
6. Select Alaska, Hawaii, California or Florida and plot its average photoperiod for the same year. Is it similar or different from your own? Explain.



Did you know that at the equator there is exactly 12 hours of daylight and 12 hours of nighttime every day!

WHAT'S FOR DINNER?

Ospreys hunt from perches overlooking water and while hovering and gliding at moderate altitudes. They are able to spot a fish from 30 to 200 feet up in the air.

Ospreys have special adaptations, different from other birds, that make them excellent fishers. They eat .5 to .8 pounds of fish a day!

When a fish is spotted, ospreys pull their wings back and free-fall to the water, feet outstretched. When the osprey approaches the water, it will plunge downward with head and feet together to catch the fish. Ospreys will even submerge themselves completely in the water.

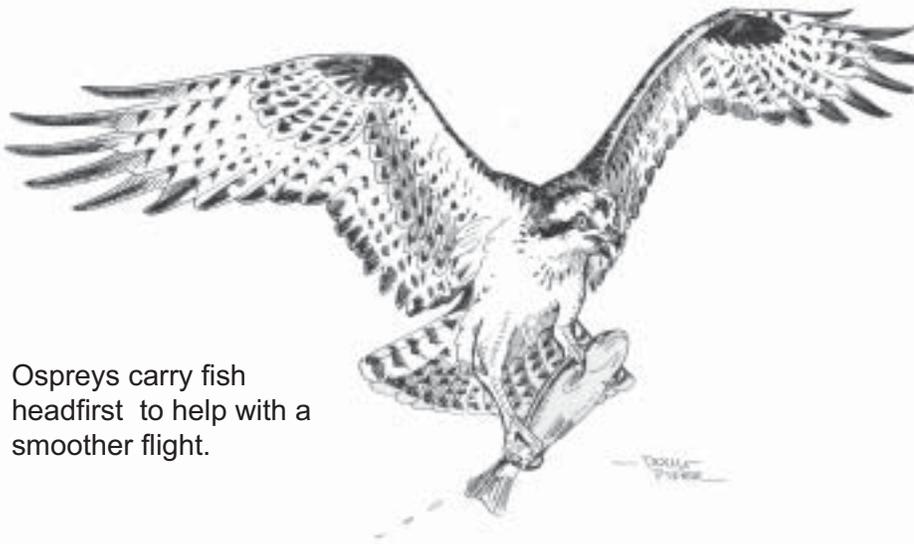
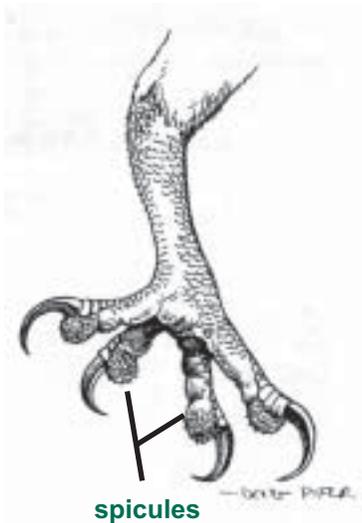
Osprey's nostrils are unusually long and slitted and may be closed during dives. Dense oily feathers and body strength allow the osprey

to shake the water off its body quickly while flying back to its perch.

Initially, caught fish are held as captured - backward, sideways, forward or even dangling by the head or tail. A very unique behavior to ospreys is carrying fish headfirst. If the fish is not caught headfirst, it is manipulated in this direction with the assistance of sharp **spicules**. This behavior helps the osprey to be more **aerodynamic**.

Once back to the perch, the osprey will use its long, sharp beak to tear the fish apart. This is important because ospreys do not have teeth!

Ospreys prefer slow-moving, bottom-feeding fish such as: catfish, carp, flounder, perch and sunfish. They may also take eels, trout, bass and pike.



Ospreys carry fish headfirst to help with a smoother flight.

OSPREY ADAPTATIONS

- very rough feet, sharp claws, strong legs and wing power used to pull fish out of the water
- lower surface of toes are covered with **spicules**
- excellent divers
- long, sharp and curved beaks to tear fish apart
- dense oily feathers
- reversible outer toe on both feet to turn fish around in its claws
- excellent vision
- ability to close its nostril when diving

-KEY WORDS-

spicules - small sharp spines on the toe pads on the bottom of the osprey's foot

aerodynamics - the study of the motion of air and other forces affecting objects or animals in motion; if something is more aerodynamic, the faster it will move

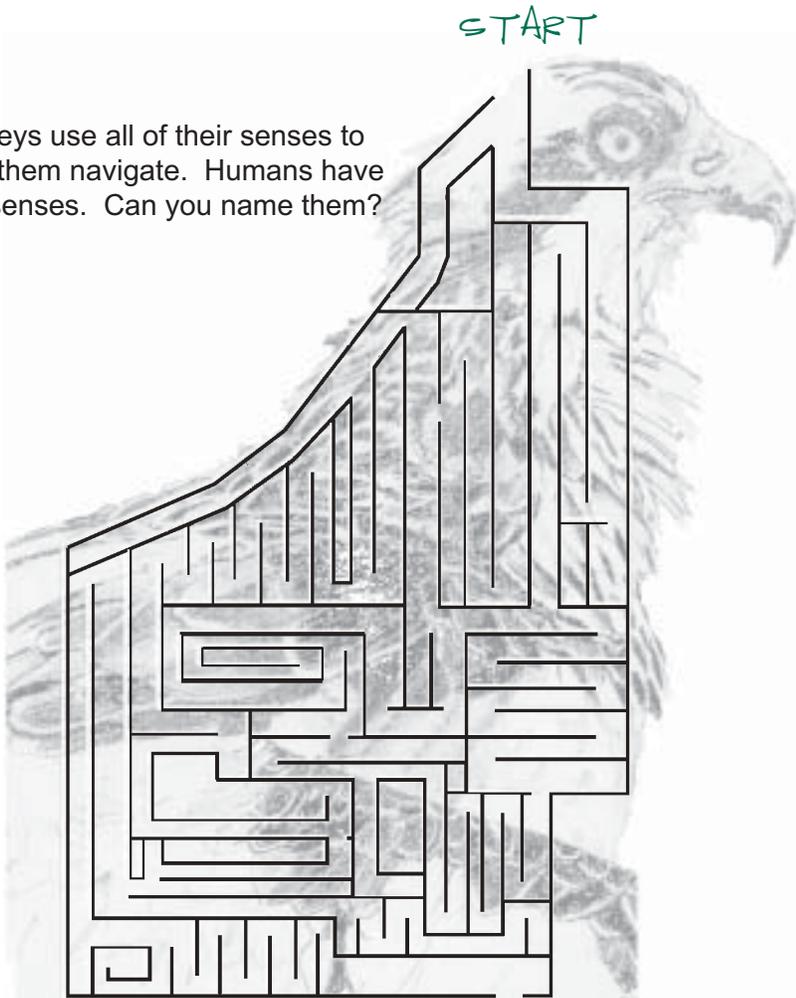
CAN YOU SPOT THE OSPREY?

See if you can find some of the osprey key words in the word find below. The words can be found up and down or diagonally, forwards or backwards.

W	B	T	I	A	G	O	F	B	M	R	U	F	M	E	Y	U	A	I	H
Y	Q	W	E	M	G	Q	I	T	Z	I	N	T	Q	G	E	Z	D	A	I
W	B	E	P	A	N	B	S	E	C	I	G	S	D	Z	N	N	A	J	M
S	R	I	G	N	I	A	H	Q	E	Q	O	R	M	J	A	H	P	F	I
E	U	I	B	D	T	Z	H	Y	B	Z	S	Z	A	K	V	V	T	B	L
L	Z	N	A	I	O	D	A	T	S	H	P	T	F	T	Q	F	A	X	Y
U	M	D	R	B	L	X	W	O	Q	O	R	B	Z	W	E	G	T	C	I
C	Q	I	B	L	I	G	K	H	S	F	E	H	C	B	J	N	I	A	A
I	N	A	H	E	P	S	U	B	Y	K	Y	G	V	J	T	T	O	L	Y
P	J	N	I	Z	J	E	G	S	U	N	A	M	S	H	P	T	N	U	Q
S	C	A	U	O	R	N	I	T	H	O	L	O	G	I	S	T	S	M	E
K	P	W	E	N	N	N	A	V	I	G	A	T	I	O	N	Y	M	U	L
J	T	H	S	M	A	R	V	I	R	F	M	P	I	K	P	I	K	S	Y
X	H	L	X	U	E	N	D	A	N	G	E	R	E	D	E	F	J	X	W
M	S	A	X	F	Y	J	R	I	R	O	T	P	A	R	C	Y	A	O	Z

- osprey
- ornithologist
- raptor
- endangered
- mandible
- nape
- calumus
- vane
- migrate
- piloting
- spicules
- adaptations
- Indiana
- NEWP
- fishhawk
- navigation
- barb
- kipkip

Ospreys use all of their senses to help them navigate. Humans have five senses. Can you name them?



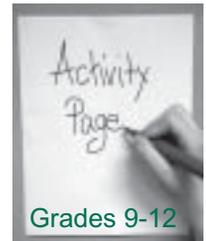
OSPREY COLLAGE

Collect your own images and see if you can make a wildlife collage of Indiana's endangered wildlife.



Images courtesy of:
Doug Pifer
Erich Hartmann
Ken Riddleberger, Georgia DNR
Indiana DNR
U.S. Fish and Wildlife Service

PASSING TRAITS: OSPREY GENETICS AND ADAPTATIONS



This activity is designed to provide a basic understanding of genetics' role in osprey adaptations. Certain adaptations allow one osprey to live longer than others. Thus, longer lives mean more opportunities to mate and more opportunities to pass their traits to a new generation.

We have created fictitious genetic traits for the osprey. Our osprey must have larger eyes so that it can see prey from long distances. Our osprey must also have a small beak so that it can tear apart the small bones in fish. These optimal traits make the osprey an expert fisher.



Dominant traits

Big eye (E)
Small beak (B)

phenotype - big eye,
small beak

genotype -EB

Traits can be determined by identifying the appropriate alleles.

Alleles:

big eye (E), small eye (e), small beak (B), big beak (b)

Notice that dominant traits are represented by a capital letter and recessive traits by a lower-case letter.

Genotypes:

big eye (EE or Ee)
small eye (ee)
small beak (BB or Bb)
big beak (bb)

Genotypes are represented by 2 alleles. One allele is passed on from each parent for each trait.



Recessive traits

Small eye (e)
Big beak (b)

phenotype - small
eye, big beak

genotype -eb

Using Punnett squares

Punnett squares can be used to determine the probability for certain outcomes with offspring. To do so, you must know the dominant and recessive genes for the trait (i.e. E=Black; e=Blonde) and the genotype for both parents. In order for a recessive trait to be expressed, both alleles must be the recessive trait. Using our examples to determine eye genotypes:

homozygous, dominant = EE
heterozygous, dominant = Ee
homozygous, recessive = ee

-KEY WORDS-

- allele* - a particular form of a gene
- dominant* - a phenotypic trait that is always expressed
- genotype* - total combination of an organism's genes
- heterozygous* - organism has related genes for different traits (Bb, Dd, Aa)
- homozygous* - organism has the genes for only one trait (ee, BB, dd)
- phenotype* - total combination of an organism's visible traits
- Punnett square* - table method used to determine what the genetic outcomes might be for offspring
- recessive* - a contrasting phenotypic trait that is not always expressed

Possible genotypes for the osprey are determined by using a **Punnett square**. This example is called a "single-factor cross" because only one trait is being determined.

Alleles		mother	
		E	e
father	E	EE	Ee
	e	Ee	ee

Possible genotypical outcomes:

- 1:4 chance of EE
- 1:4 chance of ee
- 2:4 chance of Ee

Possible phenotypical outcomes:

- 3:4 chance of big eyes
- 1:4 chance of small eyes

OSPREY SITUATION

Using the traits discussed, determine the phenotypes and 2-letter genotypes of the osprey below by looking at their physical attributes.



A



B



C



D

Genotype

Phenotype

eyes

eyes

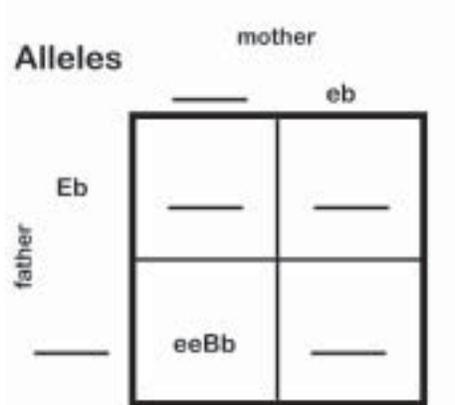
beak

beak

Punnett squares can also be used to determine the possible traits for offspring. A “two-factor cross” allows us to determine multiple traits at one time. Complete the Punnett squares below by performing a two-factor cross for eyes and beaks when a male and female pair mate.

Problem 1
 Mother: eBeb
 Father: Ebeb

Problem 2
 Mother: ebEB
 Father: EbEb

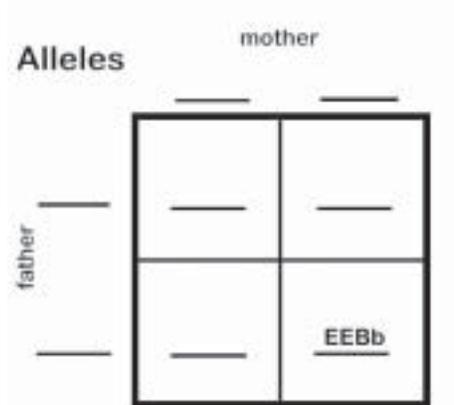


Possible genotypical outcomes:

_____ _____
 _____ eeBb

Possible phenotypical outcomes:

- _____ :4 chance of big eye, small beak
- _____ :4 chance of small eye, small beak
- _____ :4 chance of big eye, big beak
- _____ :4 chance of small eye, big beak

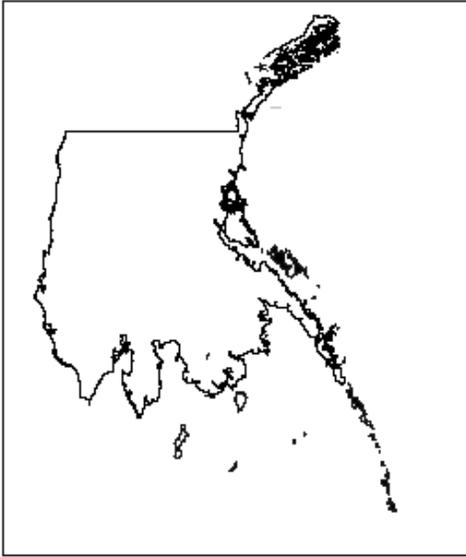
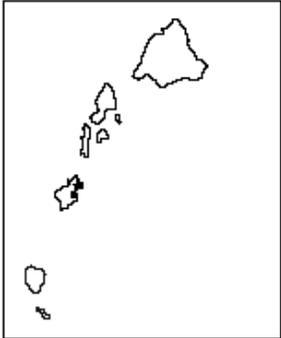
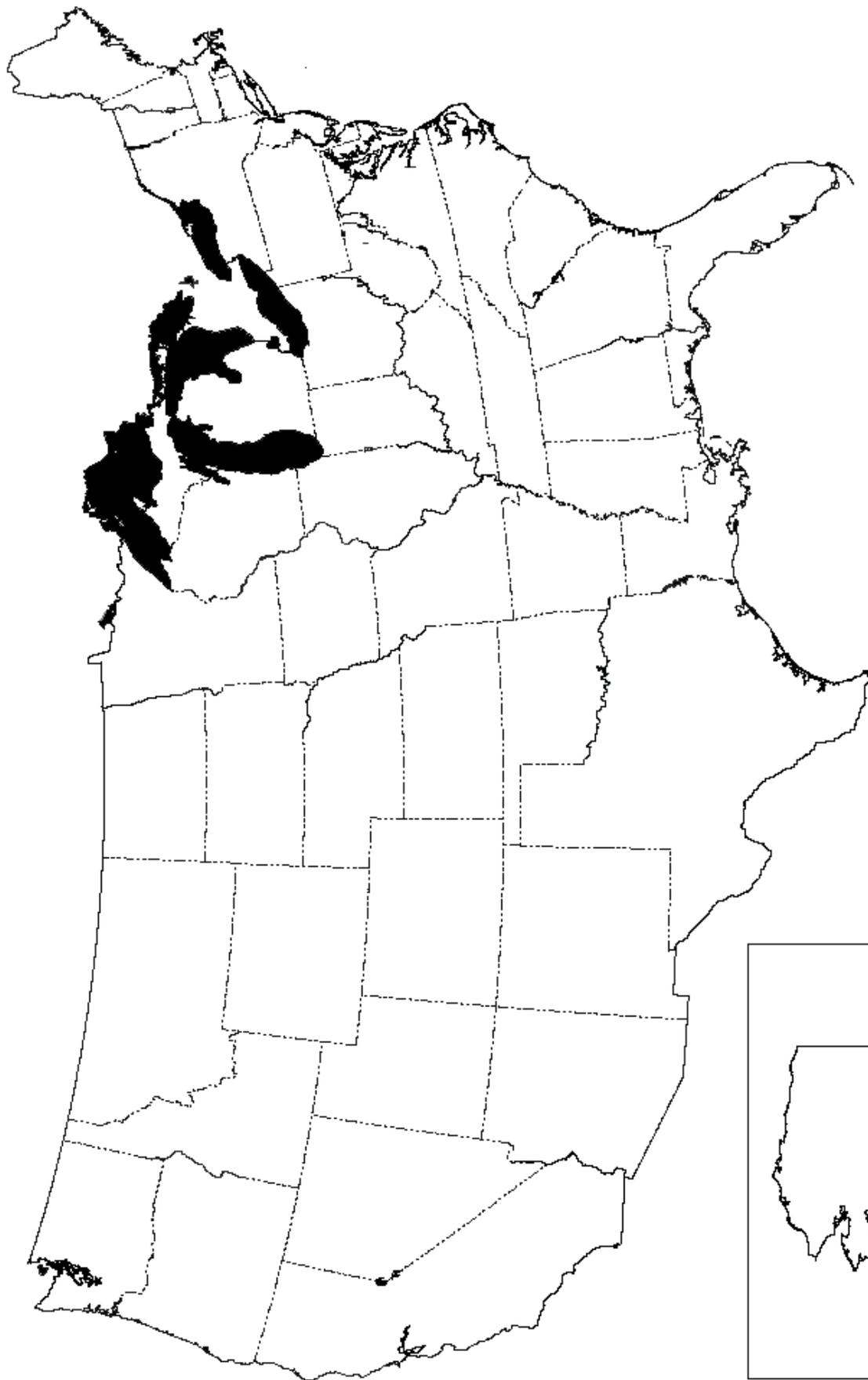


Possible genotypical outcomes:

_____ _____
 _____ _____

Possible phenotypical outcomes:

- _____ :4 chance of big eye, small beak
- _____ :4 chance of small eye, small beak
- _____ :4 chance of big eye, big beak
- _____ :4 chance of small eye, big beak



Abundance of ospreys in the United States

For use with the Internet activity on page 8.

OSPREY REFERENCES

- Allaby, Michael, ed. 1996. *The concise oxford dictionary of zoology*. Oxford, England: Oxford University Press.
- Alsop, III, Fred J. 2002. *Birds of North America: The complete guide to more than 930 species*. New York: Dorling Kindersley Limited.
- Carpenteri, Stephen. 1997. *The fish hawk: Osprey*. Minocqua, WI: Northword Press.
- Castrale, John S., Edward M. Hopkins, and Charles E. Keller. 1998. *Atlas of breeding birds of Indiana*. Indianapolis: Indiana Department of Natural Resources.
- Clark, William S., and Brian Wheeler. 2001. *Peterson field guides: Hawks of North America*. 2d ed. Boston: Houghton Mifflin Company.
- DuBois, Kristi, and Dale Becker. 1987. Identification of Montana's birds of prey. *Montana Outdoors*, November/December.
- Farrand, Jr., John, ed. 1985. *The Audubon Society: Master guide to birding*. Vol. 1. *Loons to sandpipers*. New York: Alfred A. Knopf.
- Indiana Nongame and Endangered Wildlife Program. 2003. www.wildlife.IN.gov [accessed: April 23, 2003].
- International Birding Information Resource Data. 2000. <http://i-bird.com/species/osprey.htm> [accessed: April 23, 2003].
- Mace, Alice E. 1996. *The birds around us*. San Ramon, CA: Monsanto Company.
- National Women's Hall of Fame. 2003. <http://www.greatwomen.org/home.php> [accessed: April 23, 2003].
- Natureserve. 2003. <http://www.natureserve.org/> [accessed: April 23, 2003].
- Pautuxent Wildlife Research Center: Patuxent bird identification info center. 2000. <http://www.mbr-pwrc.usgs.gov/id/framlst/framlst.html> [accessed: April 23, 2003].
- Reader's Digest Association. 1991. *The wildlife year: Life cycles of nature around the world*. London: The Reader's Digest Association Limited.
- Robinson, William L., and Eric G. Bolen. 1984. *Wildlife ecology and management*. New York: Macmillan Publishing Company.
- Toland, Brian. 1985. Missouri's eagles, hawks, falcons & vultures. *Missouri Conservationist*.
- Vanner, Michael. 2002. *The encyclopedia of North American birds*. Bath, United Kingdom: Parragon Publishing.
- Weidensaul, Scott. 1996. *Raptors: The birds of prey. An almanac of hawks, eagles, and falcons of the world*. New York: Lyons & Burford.



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